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GAS BUBBLE TRAUMA MONITORING IN THE CLEARWATER RIVER DRAINAGE IDAHO 1999

Annual Report 1999

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GAS BUBBLE TRAUMA MONITORING IN THE CLEARWATER RIVER DRAINAGE, IDAHO 1999

A Report to Bonneville Power Administration
Contract 97BI31259

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ABSTRACT

A team of two people electroshocked 39 miles of the lower Clearwater River and 1.5 miles of the North Fork Clearwater River below Dworshak Dam during the spring and summer months of 1999. This team monitored gas bubble trauma (GBT) on resident fish species during the periods of spill and non-spill from Dworshak Dam. Six thousand and eighty three fish representing 20 species were sampled for GBT. Seven fish (0.12%) were found to have signs of GBT. Sampling periods when GBT was most prevalent were temporally coincident with peak discharge and subsequent elevated levels of total dissolved gas from Dworshak Dam.

INTRODUCTION

Dissolved gas levels in the Clearwater River were expected to exceed standards of the Idaho Department of Health and Welfare, Division of Environmental Quality (110% saturation) when discharges from Dworshak Dam exceeded 15,000 cubic feet per second (kcfs) during the periods of flow augmentation for listed Snake River chinook salmon. The National Marine Fisheries Service (NMFS) requested a variance from these standards to allow a spill program that could result in total dissolved gas (TDG) levels up to 120% saturation. This activity was authorized by the Division of Environmental Quality to begin April 17 and continue through August 15, 1999.

Based on sampling conducted by the U.S. Army Corps of Engineers in 1994, TDG levels decreased continuously from below Dworshak Dam to River Mile 0.0 (confluence with Snake River). To ensure the effects of the highest TDG levels are assessed, sampling was prioritized in the North Fork Clearwater River and in the Clearwater River immediately below the confluence of the North Fork Clearwater River. To assess the extent of the effects, lower priority sampling occurred downstream to the mouth of the Clearwater River.

The emphasis of this project is to address the impacts of TDG levels on the resident fish species. Anadromous fish species (steelhead trout *Oncorhynchus mykiss*, chinook salmon *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch*, and Pacific lamprey *Lampetra tridentata*) are also in the river corridor during the defined sampling period.

STUDY AREA

The area monitored included approximately 1.5 miles of the North Fork Clearwater River from Dworshak Dam downstream to its confluence with the Clearwater River and 39 miles of the Clearwater River downstream of the North Fork Clearwater River to Memorial Bridge in Lewiston, ID (Figure 1). The study area was divided into four sections:

(Section 1)—1.5 miles of the North Fork Clearwater River between Dworshak Dam and the confluence of the Clearwater River.
(Section 2)—12 miles of Clearwater River from the confluence of the North Fork Clearwater River (RM 41) downstream to the town of Lenore (RM 29).
(Section 3)—14 miles of Clearwater River from the town of Lenore downstream to the Potlatch River (RM 15).
(Section 4)—13 miles of Clearwater River from the Potlatch River downstream to the Memorial Bridge in Lewiston, ID (RM 2).

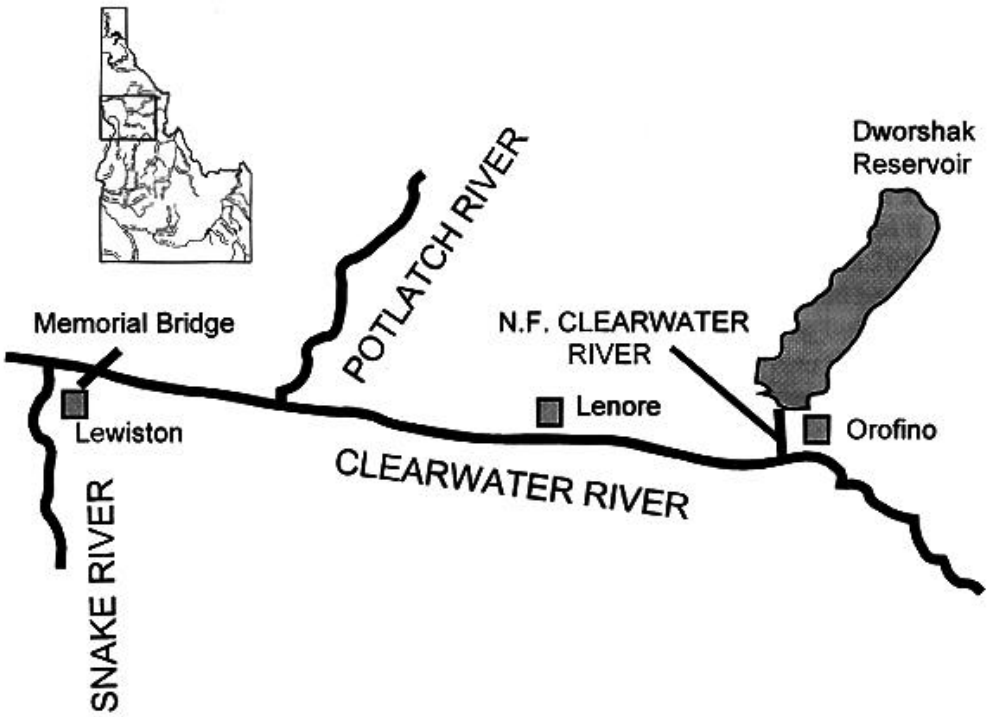

Figure 1. Location of gas bubble trauma sampling on the lower Clearwater River and the North Fork Clearwater River, 1999.

METHODS

Approximately one hundred fish were sampled from each river section weekly from April 18 through August 21, and examined for external gas bubble trauma (GBT). We attempted to capture a representative sample of each resident fish species. When possible, no species was to represent more than 30% of any given daily sample. Because potential electrofishing trauma to juvenile chinook salmon, sampling in areas where these fish congregate was avoided. Individual fish were captured using standardized electrofishing techniques. A six-meter aluminum boat, constructed for sampling large rivers, was equipped with a generator-powered pulsator providing pulsed DC electrical power to two electrodes supported by insulated booms at the bow of the boat. As fish were attracted to either electrode, they were netted and placed in a fresh flow live-well until adequate numbers were obtained for examination.

Fish were anesthetized using tricaine methanesulfonate (MS-222). Once anesthetized, we identified the fish to species, measured fork length (mm), and examined each fish for external indications of GBT (exophthalmia and macroscopic bubbles in fins and on body surfaces). The eyes, lateral lines, and all unpaired fins were examined using 2X-6X magnifying lenses and a 40X microscope. Locations and extent of bubbles were noted for each fish. The fish were then recovered in fresh water and released within the sections from which they were collected.

Based on percent area covered with gas bubbles, a GBT rank was assigned to each body part examined (fin, eye, and lateral line). A single rank was assigned for both eyes; the highest rank of either eye was recorded. If the area covered by bubbles was estimated to be near the boundary between ranks, then the higher rank was reported. A summary of ranks used in recording GBT data is listed below.

Rank	**Percent area affected**
0	0
1	1 to 25%
2	26 to 50%
3	51 to 75%
4	Greater than 75%

RESULTS

The rate of discharge from Dworshak Dam ranged from 1.3 Kcfs to 19.1 Kcfs and averaged 8.1 Kcfs during the monitoring period (Table 1). Discharge reached a maximum level of 19.1 Kcfs on August 4. Discharge ranged from 10 to 14 Kcfs from the start of the monitoring through May 18. Discharge then dropped to less than 2 Kcfs until July 19 when it increased to the highest levels of the sampling period. Dworshak discharge, by way of spill, averaged 2.03 Kcfs and peaked at 9.3 Kcfs, concurrently with the maximum level of total discharge. Total dissolved gas (TDG) levels were equal to or in excess of 110% saturation in 12 of the 18 weekly sampling periods. Levels equal to or exceeding 115% saturation occurred in 3 of the weekly sampling periods and were

associated with dam discharge exceeding 15 Kcfs. TDG levels did not reach 120% saturation during the monitoring period.

Six thousand and eighty three individual fish of 20 different species were captured during the monitoring period (Table 2). We separated rainbow trout species into five different strains based on fin clips or other physical characteristics. The most common species or strains captured are largescale sucker *Catostomus macrocheilus* (N=1,431), mountain whitefish *Prosopium williamsoni* (N=961), and hatchery steelhead trout (N=763). The most common species observed in each section were hatchery steelhead trout (section 1), mountain whitefish (section 2) and largescale sucker (sections 3 and 4) (Appendix).

Seven of the 6,083 (0.12%) fish captured and examined exhibited signs of GBT. One hatchery rainbow trout caught on April 22 in section 1 had a GBT rank of 1 on its dorsal fin. One hatchery rainbow trout caught on August 4 in section 1 had a rank of 2 on its caudal fin, and a rank of 1 on the anal fin. One hatchery rainbow trout caught on August 10 in section 1 had a rank of 1 on the caudal fin. One wild steelhead trout on August 10 in section 1had a rank of 3 on the caudal fin. One kokanee caught on August 10 in section 1 with a rank of 2 on the dorsal fin. One kokanee caught on August 10 in section 1 had a rank of 1 on its caudal fin and a rank of 1 on the anal fin. One largescale sucker caught on August 10 in section 2 had a rank of 1 on its dorsal fin.

Table 1. Average daily discharge (Kcfs) from Dworshak Dam and percent of total dissolved gases (TDG) collected immediately below Dworshak Dam, Clearwater County, Idaho, 1999. (Information provided by the U.S. Geological Survey)

	April		May		June		July		August	
Date	TDG	Kcfs	TDG	Kcfs	TDG	Kcfs	TDG	Kcfs	TDG	Kcfs
1			109	14	109	1.4	109	1.5	118	19
2			110	14.1	105	1.5	108	1.5	118	19
3			110	14	105	1.4	NA	1.5	118	18.9
4			103	10.1	NA	1.4	107	1.5	118	19.1
5			101	7.9	NA	1.3	107	1.5	118	19
6			102	8	110	1.3	110	1.5	NA	19
7			106	11.7	109	1.3	111	1.5	NA	19
8			109	14	108	1.4	107	1.5	NA	19
9			108	14	107	1.4	107	1.5	117	17.1
10			108	14	109	1.4	107	1.5	116	17.1
11			109	14	109	1.4	108	1.5	114	15.5
12			109	14	109	1.4	108	1.5	112	15
13			109	14	108	1.4	108	1.5	110	14.2
14			109	14	109	1.3	108	1.5	107	12.9
15			109	14	110	1.3	106	3.5	107	13.2
16			109	14	109	1.4	104	6.6	106	13
17			108	13.3	108	1.4	103	9	108	12.8
18	102	10.2	103	10.3	108	1.3	103	9.8	107	12.9
19	101	10.3	103	8.5	107	1.4	109	13.2	105	12.6
20	101	10.3	110	1.4	107	1.4	112	13.9	105	12.6
21	106	12.8	113	1.3	108	1.4	110	13.6	105	12.6
22	108	14	112	1.3	110	1.3	110	13.4		
23	109	14.1	112	1.3	110	1.3	110	13.3		
24	109	14.1	113	1.3	111	1.3	111	12.9		
25	110	14	112	1.3	109	1.4	110	12.7		
26	109	14	110	1.4	109	1.4	109	12.8		
27	109	14	108	1.4	111	1.4	110	12.8		
28	109	14.1	106	1.5	111	1.5	110	12.8		
29	107	13.2	106	1.5	110	1.5	111	12.8		
30	103	10.9	106	1.5	109	1.5	110	12.6		
31			107	1.4			118	18.2		

Table 2. Total number of fish captured in the Clearwater River and North Fork Clearwater River, 1999. Numbers in the parentheses indicate individual fish exhibiting signs of gas bubble trauma.

Week	BBH	BKT	BLS	BUL	CAR	CMC	CTT	HRBT	HSC	HST	KAM	KOK	LND	LSS	MWF	PKS	PMC	RSS	SCU	SMB	SQW	WRB	WSC	WST	
1	---	---	27	---	---	35	---	---	---	88	---	31(1)	---	75	75	---	2	22	11	---	5	1	---	22	394(1)
2	---	---	8	1	---	2	---	2	4	121	1	35	---	114	63	---	2	9	4	---	3	3	2	25	399
3	---	1	7	---	---	8	1	2	---	105	---	38	---	118	77	---	1	---	4	1	14	1	2	1	381
4	---	---	2	---	---	6	---	---	---	31	---	---	---	38	5	---	---	17	---	1	---	---	---	100	100
5	---	---	8	---	---	20	---	---	2	107	---	19	---	114	57	---	---	27	33	3	4	---	---	6	400
6	---	---	18	---	---	8	---	1	---	27	---	1	---	71	48	---	2	2	14	1	---	---	---	7	200
7	---	---	52	---	---	5	---	2	1	54	1	3	---	124	101	---	---	5	31	9	5	---	4	3	400
8	---	---	24	---	1	62	---	2	2	57	---	5	---	80	64	---	1	8	32	33	14	---	1	14	400
9	---	---	40	1	---	43	---	1	---	54	---	4	---	118	42	3	3	4	23	35	19	---	1	1	392
10	---	---	28	---	---	50	---	---	---	30	---	1	---	51	12	---	---	36	49	4	22	---	---	6	289
11	---	---	91	1	---	40	---	1	---	43	---	---	---	84	50	2	---	28	33	11	15	---	---	1	400
12	2	---	29	---	---	28	---	---	---	---	---	1	---	51	8	4	---	6	28	36	6	---	1	---	200
13	---	---	67	---	---	25	1	---	---	12	---	1	1	67	62	---	---	62	38	10	12	---	1	5	364
14	---	---	41	---	1	22	---	---	---	2	1	1	---	86	44	---	---	51	11	6	33	---	---	1	300
15	2	---	39	1	---	38	---	8	---	9	1	---	---	72	62	6	---	17	32	33	12	---	3	7	342
16	---	---	25	1	---	25	---	37(1)	1	7	2	3	---	50	58	1	---	103	9	3	28	3	16	5	377(1)
17	---	---	37	1	3	44	---	46(1)	1	9	---	14(2)	---	45(1)	51	1	---	37	3	26	28	---	6	24(1)	376(5)
18	---	---	24	1	---	24	---	10	---	7	1	7	---	73	82	---	---	57	16	10	38	---	11	6	367
	4	1	567	7	5	485	2	29(2)	11	763	7	119(3)	1	1386(1)	961	17	11	491	371	222	258	8	48	210(1)	6083(7)

BBH = brown bullhead (*Ameiurus nebulosus*)
BKT = (*Salvelinus fontinalis*)
BLS = bridgelip sucker (*Catostomus columbianus*)
BUL = bull trout (*Salvelinus confluentus*)
CAR = carp (*Cyprinus carpio*)
CMC = chiselmouth chub (*Acrocheilus alutaceus*)
CTT = cutthroat trout (*Oncorhynchus clarki*)
HRBT = hatchery rainbow trout (*Oncorhynchus mykiss*)
HSC = hatchery spring chinook salmon (*Oncorhynchus tshawytscha*)
HST = hatchery steelhead trout (*Oncorhynchus mykiss*)
KAM = kamloop trout (*Oncorhynchus mykiss*)
KOK = kokanee salmon (*Oncorhynchus nerka*)
LND = longnose dace (*Rhinichthys cataractae*)
LSS = largescale sucker (*Catostomus macrocheilus*)
MWF = mountain whitefish (*Prosopium williamsoni*)
PKS = pumpkinseed (*Lepomis gibbosus*)
PMC = peamouth chub (*Mylocheilus caurinus*)
RSS = redside shiner (*Richardsonius balteatus*)
SCU = sculpin spp. (*Cottus spp*.)
SMB = smallmouth bass (*Micropterus dolomieu*)
SQW = northern pikeminnow (*Ptychocheilus oregonensis*)
WRBT = wild rainbow trout (*Oncorhynchus mykiss*)
WSC = wild spring chinook salmon (*Oncorhynchus tshawytscha*)
WST = wild steelhead trout (*Oncorhynchus mykiss*)

Table 3. Maximum total dissolved gases (TDG) per sampling period (measured in section 1) and percent occurrence of gas bubble trauma (GBT) for all fish captured by section, 1999.

Date	Maximum TDG	Section1 %GBT	Section2 %GBT	Section3 %GBT	Section4 %GBT	All Sections %GBT
Apr 18-24	109	**1.06**	0	0	0	**0.25**
Apr 25- May1	110	0	0	0	0	0
May 2-8	110	0	0	0	0	0
May 9-15	109	0	0	0	0	0
May 16-22	113	0	0	0	0	0
May 23-29	113	0	0	0	0	0
May 30 – Jun 5	109	0	0	0	0	0
Jun 6-12	110	0	0	0	0	0
Jun 13-19	110	0	0	0	0	0
Jun 20-26	111	0	0	0	0	0
Jun 27- Jul 3	111	0	0	0	0	0
Jul 4-10	111	0	0	0	0	0
Jul 11-17	108	0	0	0	0	0
Jul 18-24	112	0	0	0	0	0
Jul 25-31	118	0	0	0	0	0
Aug 1-7	118	**2.86**	0	0	0	**0.27**
Aug 8-14	117	**5.26**	**1.00**	0	0	**1.33**
Aug 15-21	108	0	0	0	0	0

DISCUSSION

Maximum discharge (Kcfs) and TDG during the DEQ waiver period in 1999 were lower than the previous four years. The TDG average throughout the monitoring period was 108.76, slightly higher than 1998, but less than 1997 and 1996 (Cochnauer 1995, Cochnauer 1996, Cochnauer and Putnam 1997, Cochnauer and Davis 1998) (Table 4). During the sampling period April 18 through August 21, there were six days when percent TDG data were not available. Three of these six days were at peak discharge from Dworshak Dam. These six days were not included in the calculation of average percent TDG.

Overall, seven of 6,083 (0.12%) fish sampled showed symptoms of gas bubble trauma in1999. Though this percentage is higher than 1998 (0.02%), it is lower than 1997 and 1996.

TDG levels of 110% or greater were observed on 34 days during the GBT evaluation in 1999, the fewest in the last 4 years. TDG did not exceed 120% in 1999. Five of seven incidents of GBT were detected on August 10 in river sections one and two, directly following peak discharge (19.1 kcfs) and seasonal high TDG (118%). During the entire monitoring season, 86% (6/7) of GBT occurrences detected throughout the study were found in section one, one case was found in section 2, and no cases were found in sections 3 and 4. Five of the six fish (83%) captured in section one and exhibiting signs of GBT are believed to been entrained from Dworshak Reservoir. These fish were kokanee (3) and hatchery origin rainbow trout (2). Entrained fish withstanding, GBT detected on resident fish was 0.032% (2/6083). In section one, GBT was detected on 1.06% (1/94) of wild juvenile steelhead. In section 2, GBT was detected on 0.37% (1/270) largescale suckers.

Four of the seven fish with signs of GBT in the 1999 study scored a GBT rank of 1. The three fish remaining fish scored a rank of 2 and were all found in section 1. All fish receiving a rank greater than 1 were species likely entrained through Dworshak Dam.

Table 4. Discharge (Kcfs), duration of elevated discharge (≥20 Kcfs), and percent saturation of total dissolved gases (TDG), and occurrence of gas bubble trauma (GBT) in resident fish species.

	Discharge (Kcfs)		# of days over	**Total Dissolved Gases (%)**		**GBT**
Year	Average	Maximum	20 Kcfs	Average	Maximum	(%)
1995	8.68	22.9	12	109.15	121	0.2
1996	9.01	22.6	24	109.01	122.95	0.2
1997	14.1	25.1	51	110.63	122.96	1.02
1998	9.24	19.9	0	106.97	119	0.02
1999	9.19	19.1	0	108.76	118.26	0.12

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APPENDIX

Table A1. Number of fish captured in the North Fork Clearwater River (Section 1), 1999. Numbers in parentheses indicate individual fish exhibiting signs of gas bubble trauma.

Week	BKT	BLS	BUL	CMC	CTT	HRBT	HSC	HST	KOK	LSS	MWF	PKS	RSS	SCU	SMB	SQW	WRBT	WSC	WST	Σ
1	---	4	---	1	---	---	---	13	27(1)	20	3	---	3	4	---	---	1	---	18	94(1)
2	---	2	1	---	---	---	---	11	34	19	2	---	5	---	---	---	1	---	25	100
3	1	4	---	---	1	2	---	20	33	34	1	---	---	3	---	---	---	---	1	100
4	---	2	---	6	---	---	---	31	---	38	5	---	17	---	1	---	---	---	---	100
5	---	3	---	---	---	---	1	36	19	24	3	---	---	9	---	---	---	---	5	100
6	---	7	---	8	---	1	---	26	1	29	4	---	2	14	1	---	---	---	7	100
7	---	8	---	1	---	2	---	31	3	19	2	---	4	26	---	1	---	---	3	100
8	---	7	---	7	---	2	---	37	1	12	10	---	---	15	1	1	---	---	7	100
9	---	8	1	11	---	1	---	51	1	13	2	1	1	9	---	---	---	---	1	100
10	---	6	---	3	---	---	---	29	1	8	7	---	8	31	---	1	---	---	6	100
11	---	15	1	6	---	1	---	38	---	24	3	1	---	6	1	3	---	---	1	100
12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
13	---	16	---	---	1	---	---	10	1	1	11	---	24	16	1	---	---	---	5	86
14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
15	---	7	1	---	---	7	---	6	---	9	4	---	---	7	---	---	---	---	5	46
16	---	3	1	1	---	35(1)	1	4	3	6	6	1	---	7	1	---	3	3	2	77
17	---	3	1	1	---	35(1)	---	5	12(2)	4	7	---	---	2	---	---	---	3	3(1)	76(4)
18	---	---	1	1	---	7	---	7	7	3	15	---	1	8	1	---	---	11	5	67(1)
Σ	1	95	7	46	2	93(2)	2	355	143(3)	263	85	3	65	157	7	6	5	17	94(1)	1446(6)

BKT = brook trout (*Salvelinus fontinalis*)
BLS = bridgelip sucker (*Catostomus columbianus*)
BUL = bull trout (*Salvelinus confluentus*)
CMC = chiselmouth chub (*Acrocheilus alutaceus*)
CTT = cutthroat trout (*Oncorhynchus clarki*)
HRBT = hatchery rainbow trout (*Oncorhynchus mykiss*)
HSC = hatchery spring chinook salmon (*Oncorhynchus tshawytscha*)
HST = hatchery steelhead trout (*Oncorhynchus mykiss*)
KOK = kokanee salmon (*Oncorhynchus nerka*)
LSS = largescale sucker (*Catostomus macrocheilus*)
MWF = mountain whitefish (*Prosopium williamsoni*)
PKS = pumpkinseed (*Lepomis gibbosus*)
RSS = redside shiner (*Richardsonius balteatus*)
SCU = sculpin spp. (*Cottus spp*.)
SMB = smallmouth bass (*Micropterus dolomieu*)
SQW = northern pikeminnow (*Ptychocheilus oregonensis*)
WRBT = wild rainbow trout (*Oncorhynchus mykiss*)
WSC = wild spring chinook salmon (*Oncorhynchus tshawytscha*)
WST = wild steelhead trout (*Oncorhynchus mykiss*)

Table A2. Number of fish captured in the Clearwater River (Section 2), 1999. Numbers in parentheses indicate individual fish exhibiting signs of gas bubble trauma.

Week	BBH	BLS	CMC	HRBT	HSC	HST	KOK	LSS	MWF	PMC	RSS	SCU	SMB	SQW	WRBT	WSC	WST	Σ
1	---	---	3	---	---	43	1	8	25	---	13	4	---	---	---	---	3	100
2	---	1	1	1	1	42	---	25	23	---	4	2	---	---	---	---	---	100
3	---	2	---	---	---	34	---	23	38	---	---	---	---	2	1	---	---	100
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
5	---	1	20	---	1	30	---	10	2	---	27	7	2	---	---	---	---	100
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
7	---	2	3	---	---	18	---	42	20	---	1	4	7	3	---	---	---	100
8	---	---	8	---	---	7	---	32	38	1	3	2	1	7	---	---	1	100
9	---	19	1	---	---	3	1	41	19	---	---	1	1	6	---	---	---	92
10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
11	---	27	8	---	---	5	---	14	7	---	19	13	1	6	---	---	---	100
12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
13	---	17	1	---	---	2	---	7	26	---	8	10	2	4	---	1	---	78
14	---	11	14	---	---	2	---	23	6	---	35	---	1	8	---	---	---	100
15	---	16	6	---	---	3	---	21	29	---	4	10	2	1	---	1	1	94
16	---	11	9	2	---	3	---	4	24	---	35	2	1	4	---	5	---	100
17	3	7	17	11	---	4	1	25(1)	23	---	6	1	---	1	---	1	---	100(1)
18	---	15	---	2	---	---	---	20	47	---	3	5	1	7	---	---	---	100
Σ	3	129	91	16	2	196	3	270(1)	327	1	158	61	19	49	1	8	5	1364(1)

BBH = brown bullhead (*Ameiurus nebulosus*)
BLS = bridgelip sucker (*Catostomus columbianus*)
CMC = chiselmouth chub (*Acrocheilus alutaceus*)
HRBT = hatchery rainbow trout (*Oncorhynchus mykiss*)
HSC = hatchery spring chinook salmon (*Oncorhynchus tshawytscha*)
HST = hatchery steelhead trout (*Oncorhynchus mykiss*)
KOK = kokanee salmon (*Oncorhynchus nerka*)
LSS = largescale sucker (*Catostomus macrocheilus*)
MWF = mountain whitefish (*Prosopium williamsoni*)
PMC = peamouth chub (*Mylocheilus caurinus*)
RSS = redside shiner (*Richardsonius balteatus*)
SCU = sculpin spp. (*Cottus spp*.)
SMB = smallmouth bass (*Micropterus dolomieu*)
SQW = northern pikeminnow (*Ptychocheilus oregonensis*)
WRBT = wild rainbow trout (*Oncorhynchus mykiss*)
WSC = wild spring chinook salmon (*Oncorhynchus tshawytscha*)
WST = wild steelhead trout (*Oncorhynchus mykiss*)

Table A3. Number of fish captured in the Clearwater River (Section 3), 1999. Numbers in parentheses indicate individual fish exhibiting signs of gas bubble trauma.

Week	BLS	CAR	CMC	HRBT	HSC	HST	KAM	KOK	LND	LSS	MWF	PMC	RSS	SCU	SMB	SQW	WSC	WST	Σ
1	17	---	---	---	---	29	---	3	---	24	17	2	1	3	---	3	---	1	100
2	1	---	---	---	2	40	1	---	---	34	16	---	---	2	---	1	2	---	99
3	---	---	---	---	---	24	---	---	---	32	33	1	---	---	---	10	---	---	100
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
5	---	---	---	---	---	23	---	---	---	45	20	---	---	7	1	3	---	1	100
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
7	18	---	1	---	1	4	1	---	---	27	44	---	---	1	1	---	2	---	100
8	14	1	22	---	---	7	---	2	---	14	14	---	5	15	---	6	---	---	100
9	12	---	10	---	---	---	---	2	---	33	21	3	1	3	1	13	1	---	100
10	5	---	14	---	---	---	---	---	---	16	5	---	19	18	---	12	---	---	89
11	18	---	5	---	---	---	---	---	---	29	27	---	---	14	5	2	---	---	100
12	19	---	6	---	---	---	---	1	---	36	8	---	5	17	1	6	1	---	100
13	19	---	5	---	---	---	---	---	1	38	25	---	---	6	2	4	---	---	100
14	15	---	1	---	---	---	---	1	---	32	32	---	---	6	2	11	---	---	100
15	14	---	9	---	---	---	1	---	---	27	29	---	4	6	---	10	---	---	100
16	7	---	5	---	---	---	---	---	---	20	11	---	40	---	1	7	7	2	100
17	14	---	---	---	---	---	---	---	---	4	21	---	31	---	---	14	---	16	100
18	1	---	23	1	---	---	---	---	---	10	3	---	38	3	3	18	---	---	100
Σ	174	1	101	1	3	127	3	9	1	421	326	6	144	101	17	120	13	20	1588

BLS = bridgelip sucker (*Catostomus columbianus*)
CAR = carp (*Cyprinus carpio*)
CMC = chiselmouth chub (*Acrocheilus alutaceus*)
HRBT = hatchery rainbow trout (*Oncorhynchus mykiss*)
HSC = hatchery spring chinook salmon (*Oncorhynchus tshawytscha*)
HST = hatchery steelhead trout (*Oncorhynchus mykiss*)
KAM = kamloop trout (*Oncorhynchus mykiss*)
KOK = kokanee salmon (*Oncorhynchus nerka*)
LND = longnose dace (*Rhinichthys cataractae*)
LSS = largescale sucker (*Catostomus macrocheilus*)
MWF = mountain whitefish (*Prosopium williamsoni*)
PMC = peamouth chub (*Mylocheilus caurinus*)
RSS = redside shiner (*Richardsonius balteatus*)
SCU = sculpin spp. (*Cottus spp*.)
SMB = smallmouth bass (*Micropterus dolomieu*)
SQW = northern pikeminnow (*Ptychocheilus oregonensis*)
WSC = wild spring chinook salmon (*Oncorhynchus tshawytscha*)
WST = wild steelhead trout (*Oncorhynchus mykiss*)

Table A4. Number of fish captured in the Clearwater River (Section 4), 1999. Numbers in parentheses indicate individual fish exhibiting signs of gas bubble trauma.

Week	BBH	BLS	CAR	CMC	HRBT	HSC	HST	KAM	KOK	LSS	MWF	PKS	PMC	RSS	SCU	SMB	SQW	WRBT	WSC	WST	Σ
1	---	6	---	31	---	---	3	---	---	23	30	---	---	5	---	---	2	---	---	---	100
2	---	4	---	1	1	1	28	---	1	36	22	---	2	---	---	---	2	2	---	---	100
3	---	1	---	8	---	2	27	---	5	29	5	---	---	---	1	1	2	---	2	---	83
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
5	---	4	---	---	---	---	18	---	---	35	32	---	---	---	10	---	1	---	---	---	100
6	---	11	---	---	---	---	1	---	---	42	44	---	2	---	---	---	---	---	---	---	100
7	---	24	---	---	---	---	1	---	---	36	35	---	---	---	---	1	1	---	2	---	100
8	---	3	---	25	---	2	6	---	2	22	2	---	---	---	---	31	---	---	1	6	100
9	---	1	---	21	---	---	---	---	---	31	---	2	---	2	10	33	---	---	---	---	100
10	---	17	---	33	---	---	1	---	---	27	---	---	---	9	---	4	9	---	---	---	100
11	---	31	---	21	---	---	---	---	---	17	13	1	---	9	---	4	4	---	---	---	100
12	2	10	---	22	---	---	---	---	---	15	---	4	---	1	11	35	---	---	---	---	100
13	---	15	---	19	---	---	---	---	---	21	---	---	---	30	6	5	4	---	---	---	100
14	---	15	1	7	---	---	---	1	---	31	6	---	---	16	5	3	14	---	---	1	100
15	2	2	---	23	1	---	---	---	---	15	---	6	---	9	9	31	1	---	---	1	100
16	---	4	---	10	---	---	---	2	---	20	17	---	---	28	---	---	17	---	1	1	100
17	---	13	---	26	---	1	---	---	1	12	---	1	---	---	---	26	13	---	2	5	100
18	---	8	---	---	---	---	---	1	---	40	17	---	---	15	---	5	13	---	---	1	100
Σ	4	169	1	247	2	6	85	4	9	452	223	14	4	124	52	179	83	2	8	15	1683

BBH = brown bullhead (*Ameiurus nebulosus*)
BLS = bridgelip sucker (*Catostomus columbianus*)
CAR = carp (*Cyprinus carpio*)
CMC = chiselmouth chub (*Acrocheilus alutaceus*)
HRBT = hatchery rainbow trout (*Oncorhynchus mykiss*)
HSC = hatchery spring chinook salmon (*Oncorhynchus tshawytscha*)
HST = hatchery steelhead trout (*Oncorhynchus mykiss*)
KAM = kamloop trout (*Oncorhynchus mykiss*)
KOK = kokanee salmon (*Oncorhynchus nerka*)
LSS = largescale sucker (*Catostomus macrocheilus*)
MWF = mountain whitefish (*Prosopium williamsoni*)
PKS = pumpkinseed (*Lepomis gibbosus*)
PMC = peamouth chub (*Mylocheilus caurinus*)
RSS = redside shiner (*Richardsonius balteatus*)
SCU = sculpin spp. (*Cottus spp*.)
SMB = smallmouth bass (*Micropterus dolomieu*)
SQW = northern pikeminnow (*Ptychocheilus oregonensis*)
WRBT = wild rainbow trout (*Oncorhynchus mykiss*)
WSC = wild spring chinook salmon (*Oncorhynchus tshawytscha*
WST = wild steelhead trout (Oncorhynchus mykiss)